RELATION OF LEAF ANALYSIS OF THE CORN PLANT TO YIELD AND CHEMICAL COMPOSITION OF THE GRAIN

BY

ROBERT McLEOD REED

B.S., University of Illinois, 1947
M.S., University of Illinois, 1948

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN AGRONOMY
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UNIVERSITY OF ILLINOIS, 1952

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ACKNOWLEDGMENT

The writer wishes to express his appreciation to all those who gave assistance in this investigation. He is especially grateful to Doctors E. E. DeTurk and E. B. Earley for their helpful suggestions during the course of this work and to Dr. E. B. Earley for his aid in the preparation of the manuscript. He wishes to thank Mrs. Joan Rheumer and Mr. Fred Thorp for their help in the chemical analyses, Mr. W. J. Matthews for his assistance in the collection and preparation of samples, and Dr. K. L. Cheng for his advice about the magnesium determinations. The author is deeply appreciative of the cooperation and assistance afforded him by various members of the Soil Experiment Fields division. He also acknowledges the aid provided by Mrs. J. J. Pieper and his wife in the preparation of the manuscript.

He is also sincerely grateful to the International Minerals and Chemicals Corporation whose grant made this work possible.

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Introduction

One of the major problems of agronomic research is to determine the fertilizer needs of plants. Investigators have devised many diagnostic methods in an attempt to solve this problem. At the present time, these methods have evolved into two main groups, those dealing with the soil and with the plant.

Since leaves are very sensitive to nutrient changes within the plant, they are accurate indicators of plant needs. For this reason, leaves are analyzed to determine the percentages of essential nutrient elements present. Two main schools of thought have developed over the interpretation of leaf analysis. One group selects the critical value or level of each nutrient; the other group considers the data from the standpoint of nutrient interrelationships, or interactions. These interrelationships may be examined by the application of the concept of quantity (the sum of percentages) and quality (percentage milliequivalent composition) of nutrition which was first adopted by Lagatu and Thomas.

In this particular study, the procedure of leaf analysis was applied to corn leaves from plots on the Illinois Soil Experiment Fields. The results were interpreted on the basis of percentage composition and the quantity and quality of nutrition.

Materials And Methods

At two-week intervals throughout the growing season, leaf samples were collected from corn plants on plots at six experiment fields. Leaves of plants from various plots on two fields were subjected to chemical analyses. The fourth leaf from

the base of the stalk, minus the midrib, was used throughout this investigation. Grain samples were harvested at maturity and the yields determined.

Because of extremely large amounts of silica present in the leaves, the use of a modification of the perchloric acid method was necessary for the oxidation of the corn leaf samples. Potassium and sodium were determined by means of the flame photometer; nitrogen was determined by the Kjeldahl procedure; phosphorus was determined colorimetrically; calcium was precipitated as the oxalate and titrated with cerate; and magnesium was determined by the versenate method.

Results And Discussion

1. There was a "dilution" effect of the nitrogen in leaves from certain Hartsburg plots during the prepollination stage. This effect was probably due to a rapid increase in vegetative growth. The decrease in percentages of leaf nitrogen and phosphorus during the postpollination period may be attributed to translocation to the developing grain.

2. Potassium concentrations within the leaves declined rapidly as the plants approached maturity. Leaching of potassium from the leaves, or its return to the soil through the root system may have been factors contributing to this loss.

3. Calcium and magnesium are necessary in only small amounts for grain formation; therefore, these elements had a tendency to accumulate in the leaves rather than to be translocated to the grain.

4. Leaf samples from Hartsburg and Brownstown differed in their chemical composition. Samples from the potassium-treated plots at Brownstown contained higher concentrations of potassium than those from plots at Hartsburg, while samples from Hartsburg were higher in calcium and magnesium than those from Brownstown.

5. Ionic interactions were also involved in this study.

Calcium, magnesium and potassium gave reciprocal effects; when percentages of calcium and magnesium were high, the percentages of potassium were low. The converse of this effect was also true.

6. The relationship between yield of mature grain and percentages of individual elements in corn leaves at a given sampling time was usually good. Leaf introgen gave the best relationship to yield.

7. Low intensities and unfavorable composition units accounted for the low grain yields at both fields, when quantity and quality of nutrition were considered. Proper adjustment of milliequivalent composition units in leaves on the fully treated plot at Brownstown might result in a 20 percent increase in yield of grain.

8. Composition of corn grain was fairly constant. At Hartsburg, grain nitrogen was related to yield, whereas the other nutrient elements of the grain showed no relationship to yield.

VITA

The author was born February 13, 1922 in Chicago, Illinois. He received his secondary education in the public schools of Arlington Heights, Illinois, graduating from high school in June 1939. The following fall, he entered the University of Illinois. He received his B.S. degree in February 1947, after a 3-year sojourn in the Army where he served in the American and European theaters.

The next semester, he enrolled in the Graduate School of the University of Illinois and was awarded the Master of Science degree in Agronomy in October 1948. He worked on an advanced degree for the next 2 years at the above university. Throughout his graduate work, he was employed as a part-time Research Assistant in the Department of Agronomy. In September 1950 he accepted a position on the staff of the Agronomy Department of Oklahoma A. & M. College, where he is currently employed.

He is a member of Sigma Xi, Alpha Zeta, Phi Kappa Phi, and Gamma Sigma Delta honorary fraternities, and Gamma Alpha graduate social fraternity.